

REMARKS

The Examiner's Office Action of June 3, 2003 has been received and its contents reviewed. Applicants would like to thank the Examiner for the consideration given to the above-identified application.

By the above actions, claim 1 has been amended, and claim 12 has been cancelled. Claims 8-11 have been withdrawn in response to the election requirement of October 18, 2002. Accordingly, claims 1-7 and 13 are pending for consideration, of which claim 1 is independent. In view of these actions and the following remarks, reconsideration of this application is now requested.

Referring now to the detailed Office Action, claim 12 stands rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. The Examiner contends that since the multilayer film includes a barrier layer 104 between the first and second metal films, the multilayer film cannot consist of only two layers as recited in claim 12. Further, claim 1 stands rejected under U.S.C. §112, second paragraph, as lacking proper antecedent basis for the limitation for "via hole". In response, Applicants have cancelled claim 12 and amended claim 1, as shown above, to overcome the rejections.

Claims 1-7 stands rejected under 35 U.S.C. §103(a) as unpatentable over Kitch in view of Edelstein et al. (U.S. Patent No. 6,181,012 – hereafter Edelstein). This rejection is respectfully traversed at least for the reasons provided below.

According to the present invention, in a semiconductor device including multi-layer interconnects having air gaps, voids would form in the plug provided in the via hole if the aspect ratio of the via hole is high. In order to solve this problem, the present invention, as recited in amended claim 1, includes a semiconductor device comprising: metal interconnects made from a multi-layer film composed of a first metal film deposited on a semiconductor substrate with an insulating film sandwiched therebetween and a second metal film, which is a seed layer deposited on said first metal film, an interlayer insulating film formed over the metal interconnects, a via hole formed in the interlayer insulating film and for exposing the second metal film, and a plug made from a third metal film selectively grown on the second metal film that is exposed at the bottom of said via hole, wherein the seed layer is laminated on said first metal film.

In order to facilitate the comparison of the presently claimed invention and that of the

prior art references, Applicants are describing the present invention herein using numerically labeled features as examples.

Kitch teaches forming a metal nitride layer (CuN) (26), serving as an etch stop, between a plug (Cu) (27) and an interconnect (Cu) (25) provided in a multi-layer interconnect structure (20,22) having air voids (29). However, Kitch fails to disclose a seed layer and forming a via hole in an insulating layer (30).

On the other hand, according to the presently claimed invention, the plug (112) is formed on the seed layer (105), which is exposed at the bottom of the via hole (109) formed in the interlayer insulating film (107). Hence the present invention is different from Kitch.

Edelstein teaches forming a copper alloy seed layer (78) on a conducting diffusion barrier layer (72) to improve the adhesiveness of a copper plug (46) with respect to the barrier layer (72). However, as illustrated in Fig. 3D, the seed layer (78) is formed on the entire inner portion of the via hole (80). Hence, the plug (46) is in contact with the seed layer (78) at the entire inner portion of the via hole (80).

On the other hand, according to the present invention, since the seed layer (second metal film) (105) is laminated on the first metal film (103), the seed layer (105) is only exposed at the bottom of and within the via hole (109). Hence, the plug (112) is only in contact with the seed layer (105) at the bottom of the via hole (109).

Therefore, Edelstein fails to disclose the feature of the present invention such that the plug is only in contact with the seed layer at the bottom of the via hole due to the seed layer being laminated on the first metal film.

The requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the reference themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations.

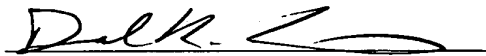
As set forth above, none of the cited prior art references disclose, teach, or suggest a plug made from a third metal film selectively grown on the second metal film that is exposed at the bottom of the via hole, wherein the seed layer is laminated on said first metal film, as recited in amended claim 1. Therefore, the combination of Kitch and Edelstein is improper in

the §103(a) rejection.

In view of the amendments and arguments set forth above, Applicant respectfully requests reconsideration and withdrawal of all the pending §103(a) rejection and §112, first and second paragraphs, rejections.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicant's representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,



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